

REMARKS/ARGUMENTS

Claims 2, 9 and 10 have been canceled. Claims 1 and 3-8 and new Claims 11-16 are active in the case. Reconsideration is respectfully requested.

The present invention relates to a process of preparing a radiation-curable urethane (meth)acrylate.

Specification Amendments

The specification has been amended in order to introduce therein appropriate section headings. Entry of the amendments is respectfully requested.

Claim Amendments

Claims 1 and 3-8 have been amended to make minor changes of terminology therein. Claim 2 is replaced by new Claim 14. New Claims 11 and 12 find support on page 6, lines 24 and 25 of the specification. New Claim 13 is supported by page 18, lines 21-25 of the text. New Claims 15 and 16 replace original Claims 9 and 10. None of the amendments and new claims introduces new matter into the case. Entry of the amendments and new claims is respectfully requested.

Claim Rejection, 35 USC 112

Applicants have retained the use of the term "partly" in the first step of the sequence of steps in both Claims 1 and 14. Applicants do not believe that the use of the term introduces indefiniteness into the claims, because it simply is another way of saying that the reaction of alkoxylated polyol with (meth)acrylic acid does not go to 100 % completion, or that it is acceptable that unreacted reactants remain in the reaction mixture after the first step reaction. Accordingly, withdrawal of the rejection is respectfully requested.

Invention

The objective of the present invention is to provide a process by which radiation-curable urethane methacrylates can be prepared that exhibit improvements in abrasion resistance, toughness with resilience, abrasion resistance and chemical resistance. This objective is achieved by a several step process of first partly reacting an alkoxyolated polyol (A) with (meth)acrylic acid (B) in the presence of at least one esterification catalyst (C) and at least one polymerization inhibitor (D) and, optionally, a solvent (E) that forms an azeotrope with water, reacting the fluid medium with a compound (G) that contains at least two epoxy groups, optionally in the presence of a catalyst (H), and reacting the fluid medium obtained with at least one polyisocyanate compound (J) and at least one hydroxyalkyl(meth)acrylate (K) and, optionally with at least one further compound (M) comprising one or more isocyanate-reactive groups, optionally in the presence of a catalyst (L).

Claim Rejection, 35 USC 102

Claims 1-10 stand rejected based on 35 USC 102(b) as anticipated by Lokai et al, U. S. Patent 6,319,983. This ground of rejection is respectfully traversed.

The Lokai et al patent is clearly relevant to the present invention because it discloses a method of making radiation-curable urethane (meth)acrylates by a several step process in which in a first step, at least one hydroxyl-containing compound is reacted with (meth)acrylic acid in a solvent, to form an ester, and then removing the solvent and optionally a part of the unreacted (meth)acrylic acid. The mixture obtained is reacted with at least one epoxy-functional compound in an amount that corresponds to the acid number of the mixture, and then reacting this material with at least one compound that contains isocyanate groups. The paragraph at the bottom of column 5 of the patent describes the esterification process in

greater detail. An important aspect of the process is that after the initial esterification, is that a portion of the solvent that is used in the process is removed by distillation and that a part of the (meth)acrylic acid is removed from the esterification medium. This is consistent with the disclosure in Example 1 of the patent at the top of column 9 where it is indicated that after the esterification, a fraction of the excess acrylic acid is removed by distillation until an acid number of 37.8 mg KOH /g was reached. Thereafter, Epikote (epoxy compound) was added in order to react with any excess acid and polyol compound. However, the reference does not appear to teach or suggest the important first step limitation of the present claims in which a significant portion of unsaturated acid ((meth)acrylic acid) remains in the reaction medium so that it is available for reaction with the epoxy compound that is added to the alkoxylated polyol.

Comparative evidence that shows the importance of the addition of an epoxy compound to a partially reacted (esterified) alkoxylated polyol is presented in the examples of the present specification. Precursor A is a comparative alkoxylated polyol which shows the removal of any excess acrylic acid reactant from an alkoxylated polyol by distillation until a product of low acid number is obtained. No epoxy compound has been added to the esterified alkoxylated polyol. This is not the case in Precursors B and C. Here, excess acrylic acid remains in the esterification medium after some of the acid has been removed by distillation. Treatment with an epoxy compound then occurs and the product low acid number esterified alkoxylated polyol was obtained in each instance. All three precursors were used to prepare urethane acrylates A1 (comparative), B1, B2, C1 and C2. The data in the table on page 33 of the specification show the superior property results obtained with the four urethane acrylates within the scope of the invention with respect to viscosity, iodine color, CH 200 m and Abrasion in comparison to the comparative Example A1.

The Examiner appears to state in paragraph 4 of the Office Action that the reaction product of step b) of the process of the patent, in the presence of a catalyst, is reacted with a polyisocyanate and a reactive diluent, as the diluents are described at column 8, lines 22-38 of the text. However, the reactive diluents described in the patent do not react in the reaction mixture of the product of step b) at the time of forming the urethane acrylates! Rather, it is important to take note of the fact that the reactive diluent of column 8 is combined with the (meth)acrylic esters which contain urethane bonds for the "purposes of processing." The patent states that such reactive diluents can be added to the (meth)acrylic esters which contain urethane bonds, if there is a desire to do so. Thus, it is clear that synthesis of the urethane acrylates is completed before combination with the reactive diluent, and that the urethane acrylates do not have additional reactive functional groups in the molecules such as isocyanate or hydroxyl groups. The only reactive groups in the urethane acrylates are (meth)acrylic groups which participate in polymerization later in the process. Neither the reactive diluents nor the urethane (meth)acrylates of the patent contain isocyanate groups or hydroxylic groups, which react with each other. Normally, the purpose of a reactive diluent is to dilute high viscosity products in order that they may be handled more easily. Thus, the use of the phrase "for the purpose of processing" by patentee. In fact, the reactive diluents of the patent contain no reactive groups other than (meth)acrylic groups. Preferred compounds are the multiple double bond containing esters of diols, triols, tetraols of (meth)acrylic acid. Note that the patent does not disclose the mono- esters of (meth)acrylic acid such as 2-hydroxy(meth)acrylate. By contrast, in the present invention, obligatory component (K) is a hydroxyalkyl (meth)acrylate such as 2- hydroxyethyl (meth)acrylate. Suitable unsaturated compounds as component K of the present invention are disclosed on pages 22 and 23, and these compounds contain at least one hydroxyl group which is reactive with isocyanate component (J), and is thereby incorporated into the urethane (meth)acrylates of the present

invention. Accordingly, whereas component (K) of the present invention does not function as a reactive diluent, but is an important part of the urethane (meth)acrylate, in Lokai et al, no hydroxyalkyl (meth)acrylates are disclosed. It should be noted that one purpose of employing hydroxyalkyl (meth)acrylates is to terminate the urethane (meth)acrylates with an easily accessible polymerizable group. Another purpose is to increase the density of the polymerizable groups within the urethane (meth)acrylates by incorporating hydroxyalkyl (meth)acrylates with more than one (meth)acrylic group such as would be achieved with pentaerythritol tri(meth)acrylate. It is believed clear that the urethane (meth)acrylates of the present invention are more versatile than those of the patent. Accordingly, the anticipatory ground of rejection is believed overcome and withdrawal of the same is respectfully requested.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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